THE BIRTH OF THE ORTHOGONAL CITY PLAN: Visual to Surveyed Representations of Rome from the 14th to 18th Century

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Abstract: Early representations of cities are shown as a staggering of selected icons, figures on a passive ground. Later in the seventeenth century, shifts in political governance lead to an increase of land value. At this point, representing cities in a visual manner is no longer efficient. A precise method is needed to record land in order to demarcate, manage, and mark ownership. With the discovery of measuring techniques and tools, cities are now surveyed and represented as an orthogonal projection. The evolution of this process takes place from the end of the Middle Ages until the nineteenth century. This paper traces back this evolution and focuses on examples that marked the transition from the visual representations to the orthogonal city plan, such as the Leonardo Bufalini plan of Rome and G.B. Nolli's *Nuova Pianta,* crucial orthogonal plan examples to assist with understanding this process. These orthogonal plans embed information on land economy in which figure, land, is equivalent to ground. They recall the origins of representing urban form as land registration that lie in the roman jurisprudence. The first cadastral registry known is *Forma,* a bronze tablet used during the roman colonization period. This document marks the beginning of representation of urban form as an abstract subject, an orthogonal projection with the intention of registering land use. In this paper, to better understand this evolution of representing the city as an abstraction, I will first look at early representations of Rome, where the origins of this transition have their roots. I will then proceed in unfolding political transformations that occurred during the transitioning periods, since it is this shift of power that lead to the necessity of recording land for renovation, fortification, and management purposes. For this, I will investigate the Leonardo Bufalini plan that applied in the 1551 survey to map the city of Rome. After Bufalini, orthogonal projection as a technique of representing urban form was not used until the 1700s when the city needed a series of renovation projects and land demarcation after the wars of reformation. The reintroduction of survey plans, and cadastral registry becomes an important tool for land management. Finally, I will end by analyzing Giambatista Nolli 's *Nuova Pianta di Roma*, where this technique reached its peak in terms of accuracy as well as influence all over Europe.

Keywords: Representation, cities, orthogonal plan, figure ground, Nolli map.

INTRODUCTION

This paper studies the evolution of city representation from early visual drawings to the birth of the orthogonal city plan. It problematizes the process of prioritization while selecting information to be shown or omitted and the reasons behind it. In early representations, cities are shown as a staggering of selected icons, figures on a passive ground. These representations intended to give an idea of the city for the use of tourists and pilgrims, their main aim being the one of recognition and memory called *Memorabilia* (Bevilacqua and Fagiolo 2012, 53). Whether in the forms of ideograms, portraits, and bird's-eye view, these early representations maintain a visual character. In the beginning of the sixteenth century with the sack of Rome, the city remained destroyed until the Council of Trent consolidated the power of the papacy and restoration and initiated renovation projects to secure its authority, *Renovatio* (Maier 2015, 1-19). The shift of power leads to the necessity of recording land for management and ownership purposes. The rediscovery and the introduction of the survey is an important act in this process. The origins of the survey lie in the Roman jurisprudence, *Forma* (figure 1), the first cadastral registry used to demarcate land during the roman colonization period (Rykwert 1976, 60). For the Romans, land division and demarcation had an important role in management, control, and resolving conflicts. All survey techniques were very meticulously defined in the *Corpus Agrimensorum Romanorum* codex (Settis 2003, 103-119). Since the origins of *Forma* lie in the Roman jurisprudence, it is only logical to look at the evolution of representation of the city in Rome. Also, because it is a city with a very unique topography, Rome is extremely difficult to represent. From early representations, we note that Rome is described, experienced, and planned in elevation due to its fragmented nature. The transition from the visual representation of this irregular scenography to the abstract orthogonal projection is of great importance.

It is marked by historical and political events, as well as by the accomplishment of major plans at the same time. Many artists and architects were engaged in the rediscovery of survey techniques and their use in representing the city accurately (Bevilacqua and Fagiolo 2012, 23-61). The survey became even more useful for fortification projects with the rise of measurement in artillery (Gerbino and Johnston 2009, 31-44). Leonardo Bufalini was the first to apply this technique in 1551 (figure 2) to measure and represent Rome (Bevilacqua and Fagiolo 2012, 23-61). After Bufalini, orthogonal projection was not used until the eighteenth century, when the city needed a series of renovation projects and land demarcation after the wars of reformation. It is with Giambatista Nolli 's *Nuova Pianta di Roma* that this technique reached its peak in terms of accuracy, as well as influence all over Europe (Bevilacqua and Fagiolo 2012). To investigate this phenomenon, I will first look at early representations, from ideograms to city portraits, then follow with accurate representations for restoration, renovation, and military defensive projects with the example of Bufalini's map. I will finally end with reintroduction of the survey, the cadastral map, and the example of Nolli Plan (figure 3).

Figure 1: Forma. Musée Municipal d'Orange (Salvatore Settis 2003)

Figure 2: Pianta di Roma. British Library (Leonardo Bufalini 1551)

Figure 3: Nuova Pianta di Roma. AA Library (Giovanni Battista Nolli 1745)

1. EARLY IDEOGRAMS TO CITY PORTRAITS

There is an overabundance of representations of Rome over time. Early representations are mainly in the form of ideograms aiming to give an idea or an image of the city. Ideograms are abstract representations of urban form that show the outline of landmarks and diagrams of itineraries mostly for tourists and pilgrims (Bevilacqua and Fagiolo 2012, 23-61). They aim to help them guide their way through the city and give them a sensation of familiarity and direction. This is a process called *Memorabilia,* which can be understood as recognition or memory. These representations were made with either vertical figures or horizontal planimetric form. An example of this is the Fra Paolino map of Rome, *Chronologia Magna* (figure 4) from 1320 (Maier 2015, 19-23). As the name suggests, it is a chronological diagram in which the city is mapped through its churches, main buildings, houses, and streets in an undifferentiated Ground. The Fra Paolino's map of Rome lacks scale or any references to measured data, and its representation of monuments and streets remains illustrative. Later, the same format is seen in Bartolomeo Marliano's ideogrammatic view (figure 5), which presented the town as a collection of isolated monuments within a schematic rendering of the walls (Bevilacqua and Fagiolo 2012, 23-61). The ideogram had origins in antiquity; for example, it is seen in the gothic manuscript illustrated by the Limburg Brothers for the Duke of Berry (figure 6). This book, *Très Riches Heures,*

regrouped several prayers and daily readings similar to a book of hours, in which appeared an iconographic descriptive miniature, for instance of the city of Rome (Nuti 1996, 43-47). In the late Middle-Ages, it evolved to include the forms of individual structures with an emerging desire to give their relative position and to incorporate some topographical features.

Another visual representational technique was called the city portrait. It usually had a circular form and gave a semi-realistic sense of the city (Nuti 1996, 43-67). These representations show important landmarks as figures in an omitted ground. The process of prioritization here consists of a selection of the figures, the icons. Only the important ones for pilgrimage and the itineraries of the *Grand-Tour* were chosen (Nuti 1996, 43-67). As a representational technique, the city portrait showed the figures in a central position and their dimensions had relational proportions. They served to promote Rome as *Caput Mundi* to the world. Therefore, they became a tool for propaganda, placing Rome as the center of cultural heritage and celebration of Christian power (Maier 2015, 1-19). For this reason, portraits were commonly used and as Lucia Nuti writes, "In all these cases the eyes of the observer are pointed to look for a selection of information that becomes a representation of the real" (Nuti 1996, 12).

They remained visual representations, which was useful for them to accomplish their purpose efficiently. The importance here was not to realistically show the urban texture of the city, but to create an illusion of the image of the city. They were realized by using different materials such as seals, frescos, paintings on canvas or woodcuts, also called xylography. A famous example that illustrates the technique of Portrait is the seal of Ludovico Il Bavaro made in 1327 (figure 7) after the declaration of his imperial authority (Nuti 1996, 43-67). Here, Rome is represented in a circular form with an accumulation of selected figures such as the fortress, *Castello*, the circular polygonal walls of fortification, urban texture with staggered buildings, and the symbolic presence of the *Colosseo*. Once completed, this seal became a recognizable image of the capital, with the figures representing its main landmarks, walls, and topography distorted to serve the purposes of propaganda (Maier 2015, 1-19). There is a process of prioritization in the making of these representations in which the figures are either exaggerated, compressed, or drastically reduced to serve the means of promotion. Another example of a city portrait would be the Taddeo di Bartolo view of Rome from 1414 (Nuti 1996, 43-67). Again, the city is represented in a circular form with its buildings, the background almost irrelevant. Similarly, Pietro del Masaio's plan of Rome from 1471 illustrates this pilgrimage and other touristic itineraries (Nuti 1996, 43-67).

Figure 4: Chronologia Magna Map of Rome. Vatican Library (Fra Paolino da Venezia 1320)

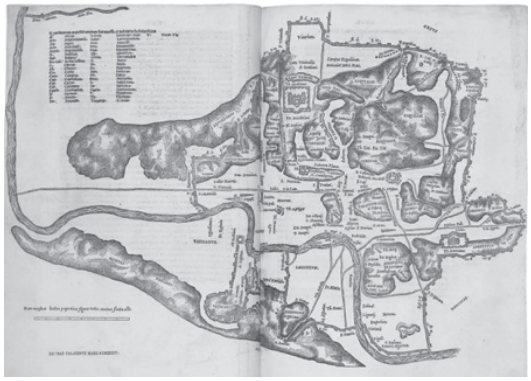

Figure 5: Urbis Romae Topographia. Columbia University Avery Architectural and Fine Arts Library (Bartolomeo Marliani 1545)

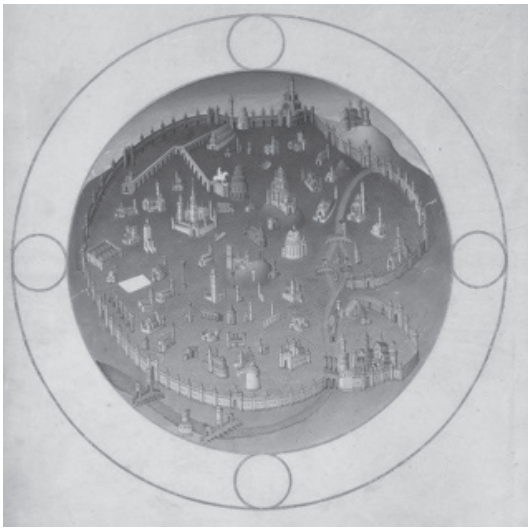

Figure 6: Très Riches Heures du Duc de Berry. British Library (Limbourg Brothers 1412-16)

These representations are overruled by the icons serving the purpose of *Memorabilia* (Bevilacqua and Fagiolo 2012, 23-61).They characterize the representational system of the period of the fourteenth and fifteenth century. Beyond the aim of recognition, portraits have a religious connotation to them as well. Circular representational technique alludes to a view of the totality of the city from above, as from God's eye, and its protection by the surrounding walls. Metaphorically, it alludes to antique pagan and Christian traditions. Oriental and Occidental Christian worlds elaborated variations of portraits during the Byzantine and Carolingian period (Nuti 1996, 48). However, if we look at the portrait's core purpose, it was to build familiarity, recognition, and a sense of safety using a visual technique. The city is seen as an isolated portion, visually recognizable and protected but without having an identity on its own, since all cities represented this way seem to have the same figures (icons). This desire enhances the necessity to see the whole of the city from above and leads to the development of the bird's eye view representational system, extremely popular at the time. Sebastian Munster's *Cosmographia Universalis* view of Rome (figure 8) is a great example that shows the axonometric drawing in formation (Bevilacqua and Fagiolo 2012, 23-61). Aspects similar to the portrait technique are kept, such as the visual character, the circular shape, the view of the whole from above, as well as the enhanced chosen icons or figures, unidentified remainder, and picturesque topography.

Figure 7: Bella D'oro. Archivio di Stato Rome (Ludovic the Brave 1328)

Figure 8: Cosmographia Universalis. Mario Bevilacqua (Sebastian Munster 1550)

2. NECESSITY OF ACCURACY

2.1. MILITARY FORTIFICATION PROJECTS

Accuracy in the measure of artillery, lines of fire and the range of cannons made it possible to plan bastioned walls for fortifications purposes. A suitable accurate representational technique was needed in a military context for defensive purposes. This technique based on survey was first used for the realization of large-scale projects in Italy, where engineers were employed in the design of fortresses. The distinction between the design process and the execution of projects gave the drawing an important dual role as a tool for planning and as a method of communication between architects and others. Issues of fortification were very important at the time and this technique became a crucial instrument for the British Royal Office to oversee, strategize, and project interventions. It is used in England in the mid-sixteenth century to design the fortress of Portsmouth a stronghold near the Pale of Calais (Gerbino and Johnston 2009, 31-44). It was applied to angled bastions as well which required an intensive use of geometry to determine their size and angle (Gerbino and Johnston 2009, 31-44).

This technique was already popular in Italy, since the end of the fifteenth century. For instance, Pope Paul III planned to fortify the third-century Aurelian circuit with a belt of bastioned walls, although only the Vatican was completed in the end (Bevilacqua and Fagiolo 2012, 23-61). So, these maps had a great use in military projects thanks to their simplified representational system as a planimetric outline. Many artists of the time, Raphael being one of them, worked on ways to create measured drawings of the Roman ruins for their restoration and conservation. These drawings would be part of a larger project; an accurate measured map of the city (Maier 2015, 1-19). This way the city becomes an orthogonal projection on paper through a process of abstraction. The same technique was already used to whole cities by Leonardo da Vinci and Giuliano da

Sangallo respectively (figures 9 and 10) for the cities of Imola and Pisa (Nuti 1996, 43-67; Bevilacqua and Fagiolo 2012).

The role of the surveyor was taken over by geometers, engineers, and architects. It is not surprising that the military commander Cesare Borgia, son of Pope Alexander VI, commissioned Leonardo da Vinci, an engineer, architect, and expert in fortification, ballistics, hydrography, instruments, and weapons of war. Da Vinci, who was working under the Duke of Milan, Ludovico Sforza, moved to Imola to survey the city and plan a fortification system for the recently destroyed town (Bevilacqua and Fagiolo 2012, 63-95). With the new techniques in measurement and artillery, a precise fortification could be planned. Da Vinci completed a survey of the town showing the outline of the city, street structure, and property boundaries, which was interesting since the primary concern was the town fortification. Not much of his survey technique is shown in this final drawing, besides pen lines dividing the circle that frames the drawing. However the irregularities in the rectilinear street plan testify to the accuracy of the map. In his survey, da Vinci marks in the margins the distances and directions to other towns and cities around Imola.

Figure 9: Map of Imola. Royal Trust Collection (Leonardo da Vinci 1502)

Figure 10: Map of Pisa. Uffizi Florence (Giuliano da Sangallo 1512-13)

This representational mode of the outline of the city, or an orthogonal projection, is the first known ichnographic plan in Renaissance. Soon, it became widely practiced among architects and engineers but remained less popular with the wider public. This translation of the ground to the drawing as an orthogonal footprint takes reference from the Italian word *Pianta*, a measured ground plan similar to the perimetric survey plan. Another important example of the use of this technique in Italy is the plan of the city of Pisa by Giuliano da Sangallo 1512-13 (Nuti 1996, 43-67). The city had been under a rebellion against under-appreciated Florentine rulers and the wall of the old Florentine fortress facing the town was pulled down. In 1509, as a result of this act, the Florentine government sent Giuliano da Sangallo and his brother Antonio to the front as military engineers to re-plan the fortifications of the city. This survey was made as a visual record of a measured urban space. It is in the form of an outline of the city. Ground plans can be called graphic representations, as they show the horizontal arrangement of a building or a town drawn to scale, sometimes displayed in numeric or linear form. The Italian word *pianta*, meaning the sole of the human foot, is applied to architecture as the footprint of the building. As seen in the map of Pisa, the city is represented solely as an orthogonal outline, a ground plan with exact measurements made through an intensive work of surveying *in situ*. The city is represented as an abstract net of measured points, in which features have different qualities, some given more importance over others. Some areas appear to be carefully recorded, whereas others are fanciful representations. For instance, most blocks are simplified and outlined, devoid of any internal structure, with a few exceptions where rows of parcels are marked along the street front, or churches are recognizable by their transept or apses. Some architectural details are included like the stairs going up to a tower or down to the river, the number of piers of the bridges, the altars of some churches, and most of all the piers and the columns. The selection of architectural features does not seem exactly random—it shows us the intention of the plan. The plan was commissioned by the ruler for the specific purpose of fortification, but the presence of land demarcations indicates a tight relationship between map and land ownership. The intentionality in this type of representation separates it from the earlier visual examples. In these orthogonal projections of cities, what is valuable is the ground, land. There is a clear transition from the visual representation to this abstract representation, in which the Figure

Ground relationship is no longer associated with icons or landmarks but is linked to data, measurement, and embedded information on land economy.

2.2. RESTORATION OF RUINS AND RENOVATION PROJECTS

As previously explored, up to the sixteenth century, maps of Rome are mainly iconographic in character, either as an ideogram or as a portrait, their goal being to provide a tool for wayfinding and propaganda through selected icons. Representation at the time was not only an instrument for pilgrims and tourists, but also used for control of the image of the city as *Caput Mundi* (Maier 2015, 1-19). This is why the representational character remained purely illustrative and visual. In the Middle Ages, Rome was perceived as the capital of the cultural world, with its iconic buildings and religious power portrayed-in its representations. However, in 1527, following the orders of Charles V, the imperial army sacked Rome as a reaction to the alliance formed between Pope Clement VII with France, England, Venice, and Florence. In eight days, thousands of churches, palaces, and houses were pillaged and destroyed. The city's pre-eminence as a Renaissance center had ended; its citizens and rulers had abandoned the city for safer and more prosperous regions. It was not until 1545 that the recently elected Pope Paul III, Alessandro Farnese, encouraged the beginning of the reformation movement (Bevilacqua 2004, 31-37). He convened the Council of Trent, which consolidated the power of papacy by revitalizing the Roman Catholic Church in many parts of Europe. Finally, Rome recovered; and a new era of construction began through the culmination of a vast series of ambitious projects of urban renewal, development, and expansion. An affluent and powerful papacy sponsors many of these projects with the aim of reestablishing the city as a world capital of culture, a hub of learning and the arts, and, above all, as a symbol of Catholic glory. Maps become an instrument of divulgation of this image and a tool of declaration of power sponsored by the popes, cardinals, and members of the religious order through specific projects. Pope Paul III, referred to as the patron of the arts, collaborated with many artists for the development of his projects to establish power and stability. For instance, he commissions Michelangelo to design and rebuild the *Campidoglio* at the top of the Capitoline Hill, Rome's civic center (Bevilacqua and Fagiolo 2012, 23-61). There is a constant intention to demonstrate power through new constructions and an interest in learning from Rome's cultural past. The eternal city is intended to become the capital of the ancient world, as well as of the new world. Therefore, restoration of the cultural heritage and remains of ruins became an important issue. The interest in antiquity was shown in paintings, which were drawn according to illusionary semblances. These paintings could not be used to reconstruct the vanishing roman ruins on paper. A more accurate and scientific representational system was needed, as Raphael points out in a Letter to Pope Leo X:

> I shall say what I think opportune so that all the measurements can be understood, and all the members of the building can be determined without error. The way the Architect draws buildings, then is divided into three parts. The first part is the plan what they mean is the flat drawing. The second is the exterior wall, with its ornaments. The third is the interior wall, also with its ornaments. (Maier 2015, 49-75)

In order to draw accurately, a method was needed that would permit one to measure and record these ruins. The survey, which was part of the roman technique as explained in the first chapter, had faded away by the Middle Ages, leaving the stage open for visual representations, such as portraits and bird's eye views. P.D.A. Harvey writes that the ancient roman tradition of representing urban form to scale died completely during the Middle Ages, with only one example being the famous St. Gall plan of the monastic complex (figure 11), akin to a miniature city (Maier 2015, 1-19). The traditional representations of towns, originally defined in Ptolemy's *Geographia,* consisted of world maps and representations of specific places and regions called *Choreographia* (Nuti 1996, 43-67). These had the characteristic of representing a place in an elevated bird's eye view showing a wider angle of the town. Although choreographies started as a measured survey, they still retained a picturesque quality. They remained a quantitative representation, in which figures of the town showing cities' landmarks, principal streets, city gates, landscapes, and neighboring villages were described. It was only with Leon Battista Alberti's treatise *Descriptio Urbis Romae* that surveying techniques were reintroduced in 1450. The method described in this treatise consisted of instructions for making a map of the city by plotting its monuments as points on a Euclidean grid (Maier 2015, 19-31). This technique served mainly to measure a structure by circumnavigating its perimeter, using a magnetic compass to note each orientation of the walls and calculating their length. Defining polar coordinates was limited to the walls and buildings of the city (figure 12) and, when applied to represent the city as a whole, was not very successful (Bevilacqua and Fagiolo 2012, 23-61).

With the rise of this method, the task of measuring and the role of the surveyor gains importance again (Crosby 1997, 3-19). This was a very important task that required knowledge in mathematics, geometry, and law. It also required specific instruments, from more simple ones such as the builder's square, level,

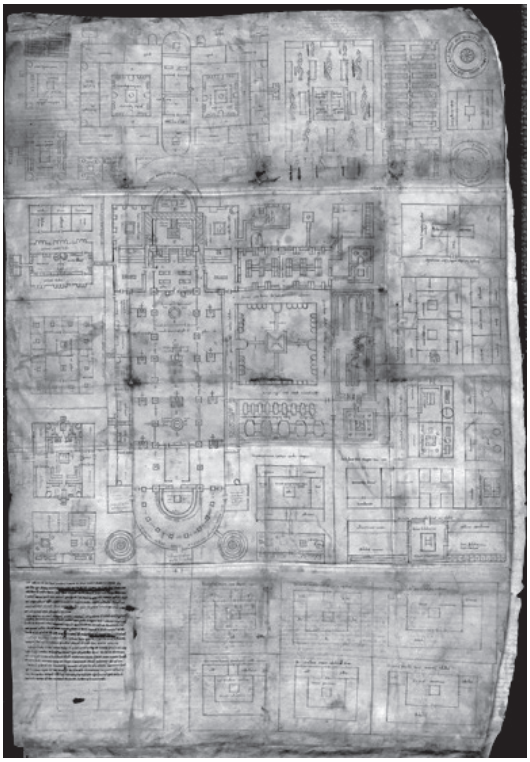

Figure 11: Saint Gall Monastery Plan. www.stgallplan.org (Reichenau 820-830)

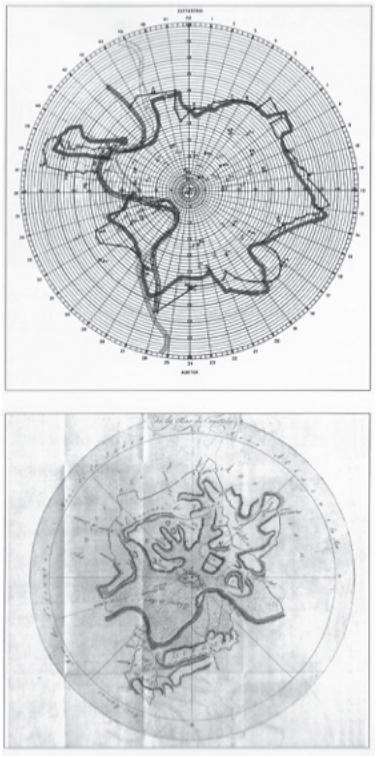

Figure 12: Descriptio Urbis Romae. Mario Bevilacqua. (Leon Battista Alberti 1451)

and compass, to more sophisticated ones, such as the plane table. The resulting survey, when applied to the city, was a measured footprint, an orthogonal projection. This sort of representation was not only useful to record an existing building, or a set of antique remains, but also to accurately plan a renovation project. These accurate representations were also used for the making of projects on site. Projects tended to have a more geometrical character, in order to facilitate their construction, thus creating a tight link between measure, mathematics and geometry. In the Middle Ages, plans were used as a tool for the communication of an idea of the whole building and its parts, as a record of contract (Gerbino-Johnston 2009, 17-30). They did not show accurate measurements and were not used on site or for planning the design process. However, with the rediscovery of survey techniques, accurate plans permitted the making of planned buildings.

2.3. LEONARDO BUFALINI'S MAP OF ROME

This method was then applied for the first time by Leonardo Bufalini in 1551 to Rome, and it is the only surviving printed map of the eternal city (figure 2). It was commissioned by the patron of the city, Pope Julius III, and was dedicated to Charles V of Spain, as well as Henri II of France. Papal power was shifting and unsteady;; balanced by other forces, the papacy consisted of a series of non-hereditary rulers, many of whom reigned only briefly and had disparate goals, or even worked at cross-purposes. Bufalini, a woodworker, engineer and surveyor from Udine was commissioned to undertake the making of this map. Although this map was issued for mainly military fortification purposes, it also revived a nostalgic, antiquarian aspect of the city. We see a horizontal ground plan of the modern city based on survey alongside the old city with the inclusion of ruins. In the collective pursuit of the investigation of antiquity of the time, ruins take on an important role in the map and are represented in their original state and not as remains. Leonardo Bufalini imposed symmetry by completing the plans of the fragmentary structures that were visible at the time. The importance of axial symmetry recalls the Vitruvian approach used by artists at the time in their reconstructions. Ruins are marked as figures on this map, floating on a semi articulated topography recalling the iconographic traditional representation. There is a dichotomy between the inhabited *intra-muros* of the city and the heritage of antiquity, the ruins (Maier 2005, 77-119). This juxtaposition makes the figure ground relationship in this map a dichotomy of two different entities. It shows

the attempts to make-Rome, not only the capital of the ancient world, but also of the modern one. The entire urban fabric including its streets, topography, natural features, and built environment are depicted in order to plan for new projects of expansion. In the early fifteenth century, the city was expanding and there was a need for more space for trades, animals, streets, markets, praying, and services outside of the church ceremonies and housing. The city grew beyond the borders and the predetermined walls (Bevilacqua and Fagiolo 2012, 23-61). An understanding of the land use becomes important, the topography as a base for new projects of expansion, as well as a document for juridical record. This surveyed representation of Rome, which started as an archeological record of historical remains, became an outline for expansion and renovation projects and fortifications (figures 13 and 14). It became a tool for the governing authority to plan projects, but also to demarcate land and secure ownership.

Figure 13: Bufalini Pianta di Roma. British Library London (Leonardo Buffalini 1551)

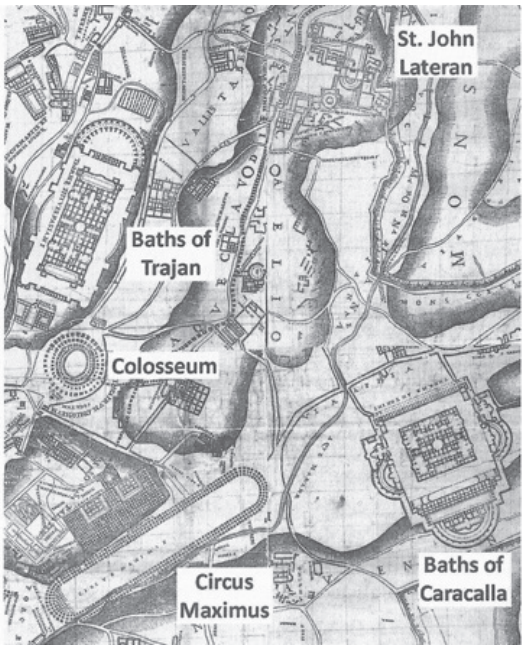

Figure 14: Bufalini Pianta di Roma. British Library London (Leonardo Buffalini 1551)

3. FROM CADASTRAL REGISTRY TO ORTHOGONAL MAPS

3.1. REINTRODUCTION OF SURVEY PLANS

After the making of Bufalini map, Rome went through ravaging times. By the beginning of the eighteenth century, the geopolitical situation in Europe becomes unstable with the conflicts between the Lutheran and Catholic Reformation. Finally, after thirty years of war, the peace of Westphalia was established, and Rome reached its artistic and urban splendor. The number of inhabitants in the city increased and its urban fabric flourished through a series of new expansion projects (Bevilacqua 2004, 31-37). However, in the mid-eighteenth century the prestige of Rome faced a decline. It was perceived as the capital of Christianity, stuck in the past and corrupt. The enlightenment ideology that dominated this period challenged the antiquarians for a more scientific and mathematical development of baroque Rome (Bevilacqua 1998, 65-80). This approach consisted not only in accurately measuring and representing the city, but also in understanding land use and value, because land had become the major factor of trade and production for the highly populated city. At the same time, land was a political tool of control and exertion of power of authorities over their city. So, in managing, expanding, and rebuilding, it became very important to have an adequate representational system. The survey was reintroduced to measure and represent land demarcation, ownership, and use and it resembled an outline of the city, a perimetrical cadastral registry. The roots of this registry and survey are attributed to the roman jurisprudence as discussed in the first chapter (figure 1). During colonization, the Romans used the survey as a basis for cadastral registry to demarcate land and ownership. It was also very useful in case of conflict (Settis 1983, 72-85). So, registration of land for the purposes of demarcation and ownership was used in the form of a perimetric outline. It was used in England, in the early modern architectural practice, as well as for administrative responsibilities related to the care of estates. Indeed, the earliest masons' ordinance, the Cooke and Regius manuscript, dates from the late fourteenth and early fifteenth century, a book on the art of masonry and the science of geometry and survey. This mathematical culture was also seen

in Leonard Digge's *A Boke named Tectonicon,* dated 1556, that explained land and material survey (Gerbino and Johnston 2009, 45-49). This technique was fully applied to the remaking of the city of London after the fire of 1666, when the Society sought a rapid method to survey the city, in order to legitimize land ownership and start reconstruction projects immediately. As an example, Sir John Evelyn, founding member of the Royal Society, made a representation of a portion of his property (figure 15). It was then proposed by Christopher Wren, an enthusiast of this mathematical representation, and also a founding member of the Royal Society, in order to make a cadastral survey of the entire city (Gerbino and Johnston 2009, 95-96). John Ogilby and William Morgan, both engineers, were charged with undertaking this enterprise (Bevilacqua and Fagiolo 2012, 63-95). The entire city was surveyed, and the map was completed in 1676. It became a record of ownership through plots and lots, as well as a base for reconstruction projects (figure 16). This map was produced thanks to the surveyor, an expert in measuring land accurately and then transferring this data into an orthogonal representation of urban form. In this form of representation, figure ground becomes one abstract entity, the one of the measure or data, which demarcates land and indicates information on the ownership status.

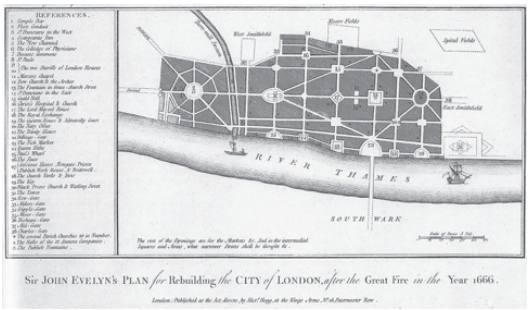

Figure 15: Sir John Evelyn Map of London. British Museum London (Sir John Evelyn Map of London 1666)

Figure 16: Morgan-Ogilby Map of London. British Library London (John Ogilby and William Morgan 1676)

3.2. CADASTRAL REGISTRY

The same logic of survey and an attempt at an orthogonal projection of the city is applied to Rome in 1723 in a period when Rome was caught in a destruction-reconstruction cycle, due to its unstable political organization. Only in the eighteenth century did Rome become more stable, as the alliances between the popes' families made it more governable. At this moment, the governing popes decided to focus on urban reform projects instead of building new monuments, in order to stabilize their power, almost as if the rulers' authority was transferred to the ground. The Nolli map was commissioned for the planning of these projects. This map was not a regular city map but an instrument for city management (figure 3). It aimed to reflect the stability of the papal estate and its government with expansion and renovation projects, making the city the capital of Christianity. Nolli was an engineer, architect, and surveyor from Como who was commissioned and sponsored by the Cardinals Albani and Baldani, Marquis Capponi and Corsini and The Baron Stosch and banker Belloni, the protagonists of the power structure of the time. This enterprise was led by Diego Revillas, cartographer and antiquarian who had worked with Nolli before in Milan (Bevilacqua 1998, 35-47). Nolli received his education in Milan and worked at the *Cadastro Teresiano* (figure 17) where he authored various works (Bevilacqua and Fagiolo 2012, 371-447). The *Cadastro Teresiano* as explained in The Cadastral Map in the Service of The State was born:

> "In the emergent societies of Renaissance Europe, where land became a commodity and power relations were expressed through control of the means of production, which included land, there was now clearly a reason for mapping properties- namely, as an aid to developing the new systems of exclusive rights to land" (Kain and Baigent 1992, 1-7).

The cadastral map was the result of a very precise survey and its representation as an outline of the city, a perimeter. It contained crucial information on land economy. In this concept, localized authority could measure and register properties and the increasing land led to the quantification of land as a commodity and claim taxation. Similar to the act of survey and the birth of the cadastral registry, quantification of land had its roots in the tradition of roman jurisprudence. In the roman law, *Corpus Iuris Civilis*, quantification of land was clearly defined; public and the private (Thomas 2002, 1431-5). These categories were useful to define an abstract value of things and to organize a sense of commerce and taxation policies. Territory was organized according to this law; delimitation of the ground was done in terms of in which category

it would be used. With this tradition, once surveyed land is registered into a cadastral map and its use is defined, it becomes possible to apply taxation policies. For instance, tax reform was applied in Italy in the state of Milan ruled by Charles VI and continued by his successor Maria Theresa of Austria (Kain and Baigent 1992, 175-95). It was an initiative that linked the ruling authority to the ground, creating an interdependence between measurement and power. Here we can say that measurement became a political gesture that incorporated law, mathematics, and trade. The use of the cadastral map was exactly the result of this initiative, a representational system that aimed to unite the land under a centralized authority, the ruler, who as decision maker empowered local estates to levy taxes. The link of authorities to the ground, based on a survey making land a commodity, entailed and benefited from a new set of rules. This tax reform, the *censimento,* marked a change of income from land different from the medieval period, which was not calculated by reference to area-based quotients, but derived from possession of rights over specific tracts of land (Kain and Baigent 1992, 175-95).

3.3. G.B. NOLLI NUOVA PIANTA DI ROMA

The *Nuova Pianta di Roma* was initiated with these principles in mind. It was a hybrid of the cadastral registry and earlier attempts at perimetric representation as the Severian Marble plan of Rome; *Forma Urbis Romae* and Leonardo Bufalini's plan of Rome (figure 2). It is defined as an orthogonal projection showing the link between land demarcation and production. In this context, it aimed also to show the archeological layer of the city in a period of decline, an attempt to renovate the city and maybe change its image too. It was made out of twelve copper plate engravings that together measures 176 centimetres (69 in) by 208 centimetres (82 in). The process consisted in a meticulous ad vivum survey of parcels of city drawn into a disegno preparatorio (Bevilacqua 1998, 65-83). The exactitude of this preparatory drawing was realized thanks to survey tools, as well as the invention of the plane table, *tavola pretoriana* that enabled drawing on site (figure 18).

The results of this survey were so accurate that the *Nuova Pianta di Roma* was used until the urban reforms of the twentieth century (Bevilacqua 1998, 65-80). A particularity of this representation, if we compare it to its precedent earlier attempts, is that beyond an outline or a cadastral registry, it also incorporated the plans of major buildings. Monuments such as churches, atria, internal courtyards, stairs and open spaces were represented in detail, as well as the ruins (figure 19). As in Leonardo Bufalini's map, Giambattista Nolli's *Nuova Pianta di Roma* started as an archaeological survey and ended by representing land economy. In this method, the striking relationship of figure ground lies on the fact that the built space is the figure becoming one with the ground. Almost as figure, the buildings and the land are represented as the same in this orthogonal projection. The dichotomy of the pair figure ground, black and white is emphasized by a new actor: the *poché.* It represents interiors as if a virtual cut was made into the built mass. In the Nolli map this technique is applied to the whole city, not only to prioritized buildings as in Bufalini (figures 2-3). So, the process of prioritization here concerns the whole city. The dichotomy is applied to the built mass

Figure 17: Cadatro Teresiano. Archivio di Stato (G.B. Nolli 1722)

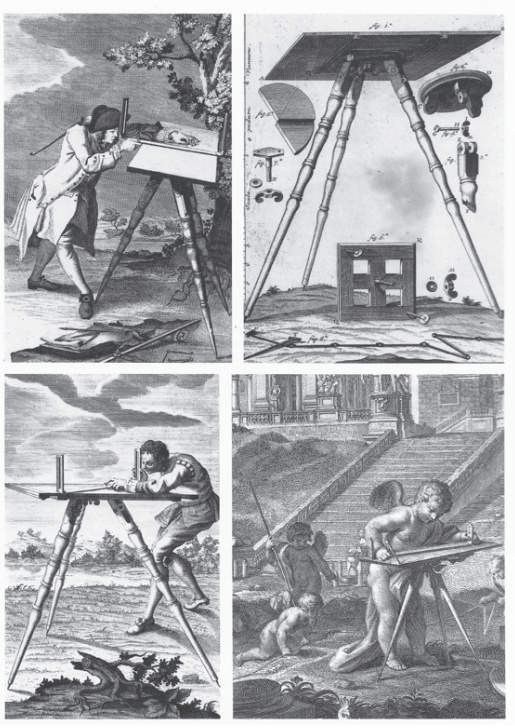

Figure 18: Plane Table. Mario Bevilacqua (*G.B. Nolli 1722*)

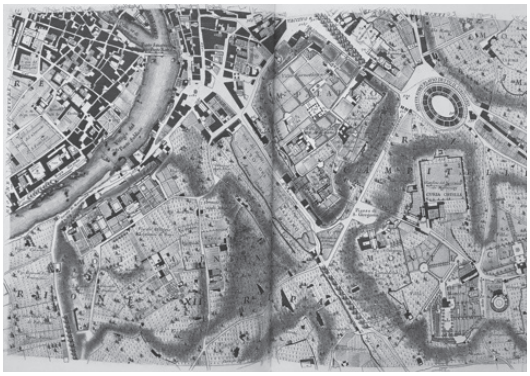

Figure 19: Detail Pianta Nuova. AA Library (G.B. Nolli 1722)

Figure 20: Detail Pianta Nuova. AA Library (G.B. Nolli 1722)

comprised of the architectural features against the unbuilt urban topography. This approach rejects the over simplistic understanding that we have of the Nolli map seen as an illustration of the private over public. Some of the buildings that are shown, that according to this approach, would be considered public (such as church courtyards for instance), are in fact private. Hence this point also reinforces the argument of this paper, which shows the use of this map as an instrument for land management, a tool to plan projects and economy. So here figure ground is the technique that permits the separation of the architectural from the urban. Hence it is an indicator of fixed features seen in *poché* over the ones enabling a possible reform represented in black. Also, the land for production is carefully denoted (figure 20) and the figure ground representation becomes a tool for management of the agricultural abundance (Marin 2001, 201-18). After the making of this map, which was a very tedious and expensive venture, it was promoted and copied in important cities all over Europe as the model to follow.

CONCLUSION

In this paper, I aimed to look at the evolution from the early representation of cities, specifically of Rome, to those completed in the eighteenth century and the influences behind their evolution. There is a clear transition from a visual to a surveyed representation. It is guided through its purpose and reflects the authority governing the city as representations of cities become a political gesture, a link between the governmental authority and the ground. Early representations fulfilled a visual character for the purpose of recognition and tourism. Landmarks and important icons were prioritized and become the figure over an omitted ground. These representations whether as a portrait, an ideogram or a bird's eye view, maintained an iconographic figure ground character. With the rising needs of military fortification projects and the rediscovery of the survey, measured accurate maps were used first to plan and strategize defense. As seen with Leonardo Bufalini's plan of Rome, the survey becomes a tool for planning restoration, renovation, expansion and fortification projects. It starts as a cadastral survey map that shows the perimetric outline of the city and is very different from visual representations because it embeds information on land demarcation and ownership. It is used to both plan the city and to communicate with different parties involved in the decision making, execution and construction. Then, it evolves to become an orthogonal projection of the city as seen in the last example, the G.B. Nolli's *Nuova Pianta.* At this point, it is a definite tool used to manage the city. This orthogonal projection of the city creates an abstract link of power to the ground. Entities prioritized as figure or ground become the instrument of land management. The orthogonal map, an abstract figure ground dichotomy represents the production in the city a politico- economic project. It is used as a tool for land demarcation, ownership and taxation. The orthogonal map becoming a tool to quantify land and its commodities. The shift in representations and use also reflects the shifting governmental system behind it, from a centralized authority towards a system based on land quantification.

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